



# The Tornado



Q. What is a Tornado?

A. A tornado is defined as a violently rotating column of air extending from a thunderstorm to the ground. The most violent tornadoes are capable of tremendous destruction with wind speeds of 250 mph or more. Damage paths can be in excess of one mile wide and 50 miles long. In an average year, 800 tornadoes are reported nationwide.

Q. How do tornadoes form?

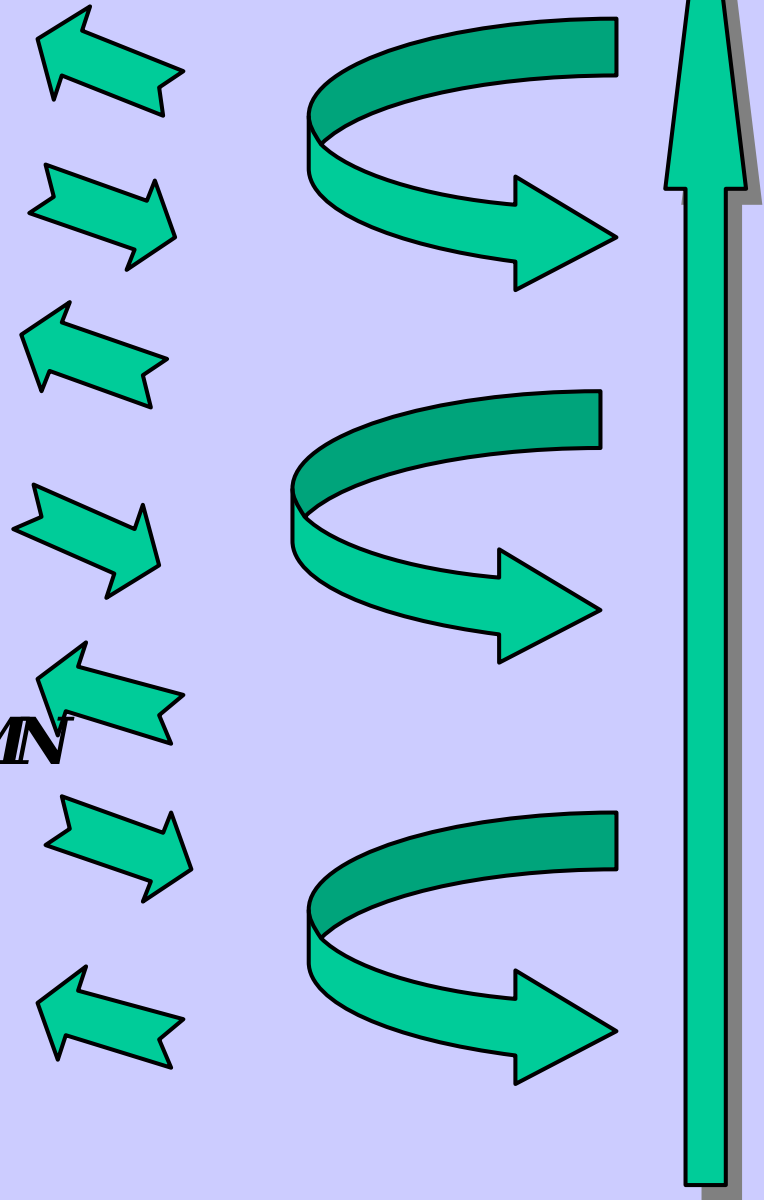
A. Before thunderstorms develop, a change in wind direction and an increase in wind speed with increasing height creates an invisible, horizontal spinning effect in the lower atmosphere. Rising air within the thunderstorm updraft tilts the rotating air from horizontal to vertical. An area of rotation, 2-6 miles wide, now extends through much of the storm. Most strong and violent tornadoes form within this area of strong rotation.

# **MESOCYCLONE-**

**•THE BIRTHPLACE OF THE TORNADO WITHIN THE THUNDERSTORM CLOUD.**

**•AS AIR RISES IN THE STORM, IT ENCOUNTERS VERTICAL WIND DIRECTIONAL AND SPEED SHEAR.**

**•IN TIME, THE ENTIRE COLUMN OF AIR ROTATES COUNTER-CLOCKWISE UPWARD IN THE CB CLOUD.**



## ***MESOCYCLONE (CONT)-***

- ***THE MESOCYCLONE IS AN AREA OF LOW PRESSURE***
- ***AS AIR RUSHES INTO THE LOW PRESSURE, SPEED INCREASES.***
- ***THE MESOCYCLONE STRETCHES VERTICALLY AND SHRINKS HORIZONTALLY.***
- ***THE AIR RUSHING INTO THE MESOCYCLONE ASCENDS WITH INCREASING SPIN AND ACCELERATION***



Q. Are there different kinds of tornadoes?

A. Some tornadoes may form during the early stages of rapidly developing thunderstorms. This type of tornado is most common along the front range of the Rocky Mountains, the Plains, and the Western State. Tornadoes may appear nearly transparent until dust and debris are picked up. Occasionally, two or more tornadoes may occur at the same time.

Waterspouts are weak tornadoes that form over warm water. Waterspouts are most common along the Gulf Coast and southeastern states. In the western United States, they occur with cold late-fall or late-winter storms, during a time when you least expect tornado development. Waterspouts occasionally move inland, becoming tornadoes causing damage and injuries.

Tornado south of Dimmit, TX Jun95





Waterspout, coastal Australia





Q. What should people look for to identify likely conditions for tornadoes?

A. Dark, often greenish sky; large hail; wall cloud; a loud roar, similar to a freight train. Some tornadoes appear as a visible funnel extending only partially to the ground. Look for signs of debris below the visible funnel. Some tornadoes are clearly visible while others are obscured by rain or nearby low-hanging clouds.



Shelf Cloud near Lindsay, OK





Q. When are tornadoes most likely to occur?

A. Tornadoes can happen any time of the year and any time of day. In the southern states, peak tornado season is from March through May. Peak times for tornadoes in the northern states are during the summer. A few southern states have a second peak time for tornado outbreaks in the fall. Tornadoes are most likely to occur between 3 p.m. and 9 p.m.



Q. Should I open my windows before a tornado approaches?

A. It's a myth that open windows equalize pressure and minimize damage when a tornado strikes. Opening windows allows damaging winds to enter the structure. Leave the windows alone and immediately go to a safe place.

Q. Doesn't the low pressure associated with a tornado cause buildings to explode?

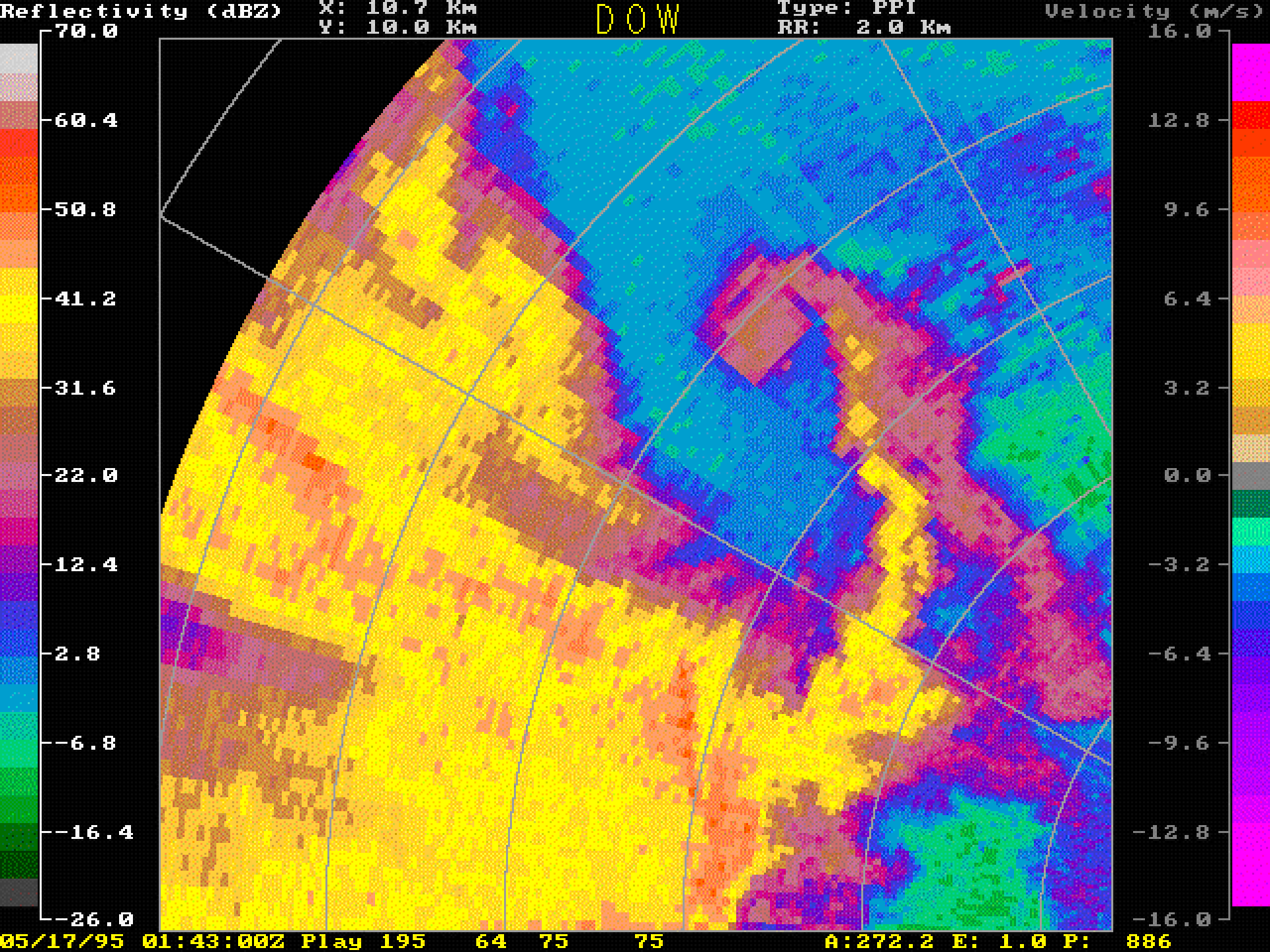
A. Violent winds and flying debris slam into buildings and cause most structural damage



In the evening of March 25, 1948, a tornado roared through Tinker Air Force Base (AFB), Oklahoma, causing considerable damage, a few injuries, but no fatalities. However, the destruction could have been much worse. A few hours earlier Air Force Captain Robert C. Miller and Major Ernest J. Fawbush correctly predicted that atmospheric conditions were ripe for tornadoes in the vicinity of Tinker AFB. This first tornado forecast triggered a chain of events, which led to the present day severe storms forecast system and a vast national research program investigating these killer storms.

Through a tremendous investment in research, observing systems such as the Doppler radar, and forecasting technology, the National Oceanic and Atmospheric Administration's National Weather Service issues more than 15,000 severe storm and tornado watches and warnings each year. The average lead time for warnings has increased from 6 to almost 12 minutes from 1994 to 1998. This means that individuals and communities have more time to prepare for tornadoes by seeking shelter and securing property, thereby reducing loss of life and limiting the economic costs of property damage. Several centers and laboratories within NOAA are dedicated to research efforts to further improved forecasts and daily forecast operations to protect life and property.





## **Watches versus Warnings**

Many people confuse the meaning of a tornado "watch" and tornado "warning" issued by the National Weather Service. Here's the difference:

Watch: tornadoes are possible in your area; remain alert for approaching storms.

Warning: A tornado has been sighted or indicated by weather radar. If a tornado warning is issued for your area and the sky becomes threatening, move to your pre- designated place of safety.



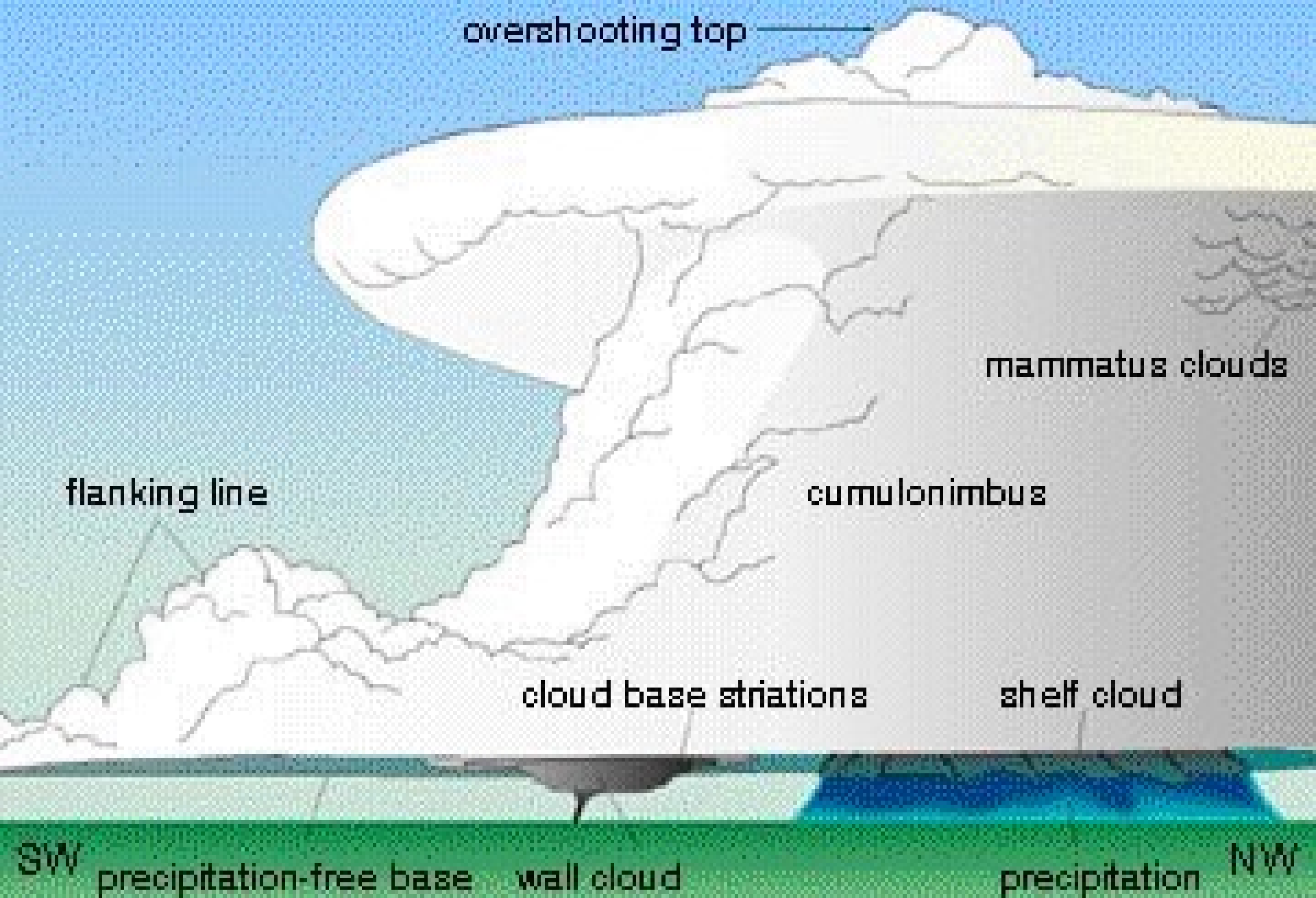
## ***When and Where:***

Whenever and wherever conditions are right, tornadoes are possible, but they are most common in the central plains of North America, east of the Rocky Mountains and west of the Appalachian Mountains. They occur mostly during the spring and summer; the tornado season comes early in the south and later in the north. They usually occur during the late afternoon and early evening. However, they have been known to occur in every state in the United States, on any day of the year, and at any hour. They also occur in many other parts of the world, including Australia, Europe, Africa, Asia, and South America.

## ***What:***

Tornadoes come from the energy released in a thunderstorm. As powerful as they are, tornadoes account for only a tiny fraction of the energy in a thunderstorm. What makes them dangerous is that their energy is concentrated in a small area, perhaps only a hundred yards across. Not all tornadoes are the same, of course, and science does not yet completely understand how part of a thunderstorm's energy sometimes gets focused into something as small as a tornado.



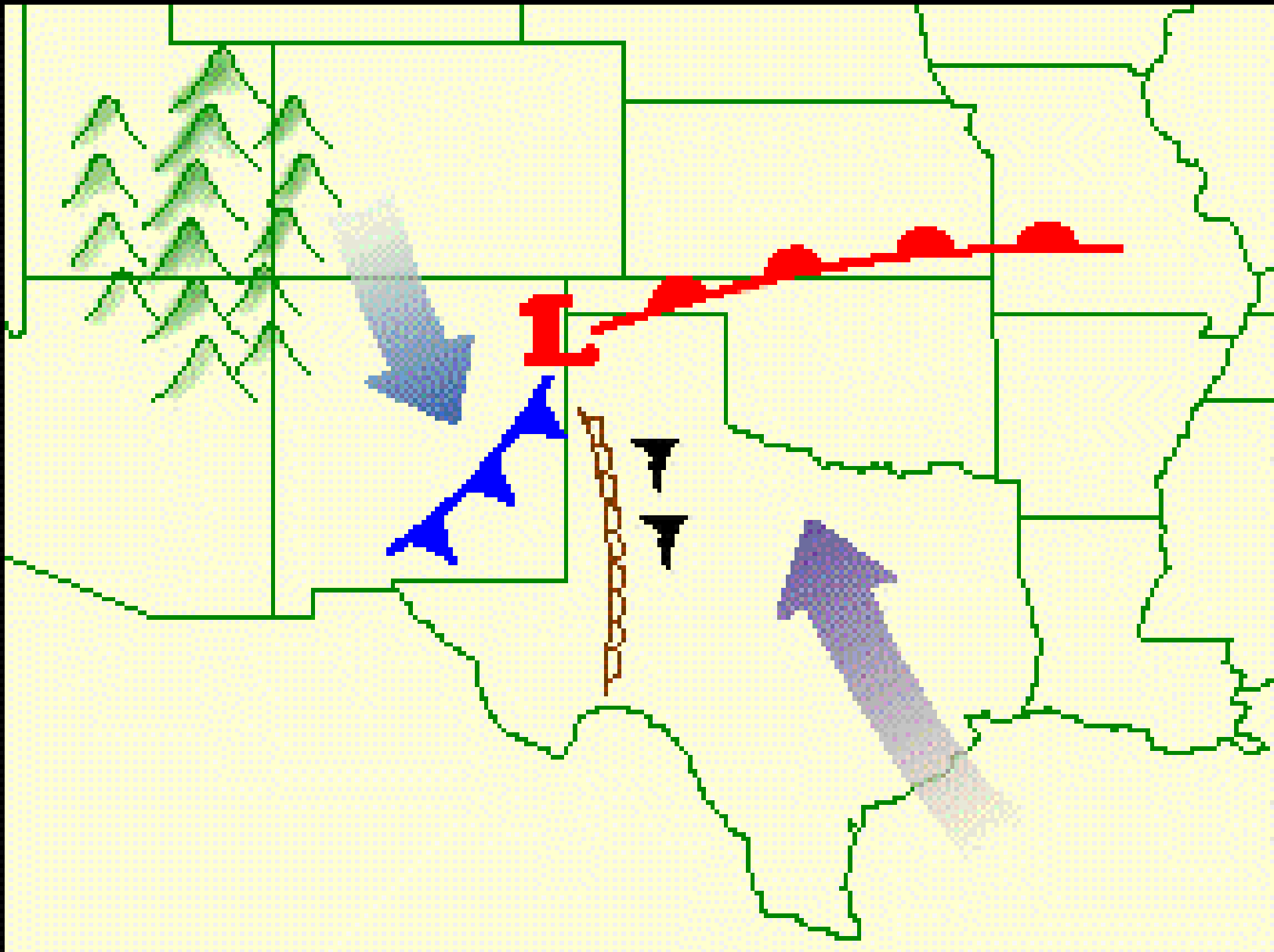


Schematic Diagram of Thunderstorm

## ***How:***

Research has revealed that tornadoes usually form under certain types of atmospheric conditions. Those conditions can be predicted, but not perfectly. When forecasters see those conditions, they can predict that tornadoes are likely to occur. However, it is not yet possible to predict in advance exactly when and where they will develop, how strong they will be, or precisely what path they will follow.





The damage from tornadoes comes from the strong winds they contain. It is generally believed that tornadic wind speeds can be as high as 300 mph in the most violent tornadoes. Wind speeds that high can cause automobiles to become airborne, rip ordinary homes to shreds, and turn broken glass and other debris into lethal missiles. The biggest threat to living creatures (including humans) from tornadoes is from flying debris and from being tossed about in the wind.

Tornadoes are classified according to the damage they cause. Through observational studies, T. Theodore Fujita created the following scale in the late 1960's to classify tornadoes. The scale correlates wind speeds with damage: F-0 is the weakest and F-5 the strongest.



## **Fujita Tornado Intensity Scale**

**Category F0:** **Gale tornado (40-72 mph);** light damage. Some damage to chimneys; break branches off trees; push over shallow-rooted trees; damage to sign boards.

**Category F1:** **Moderate tornado (73-112 mph);** moderate damage. The lower limit is the beginning of hurricane wind speed; peel surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off the roads.

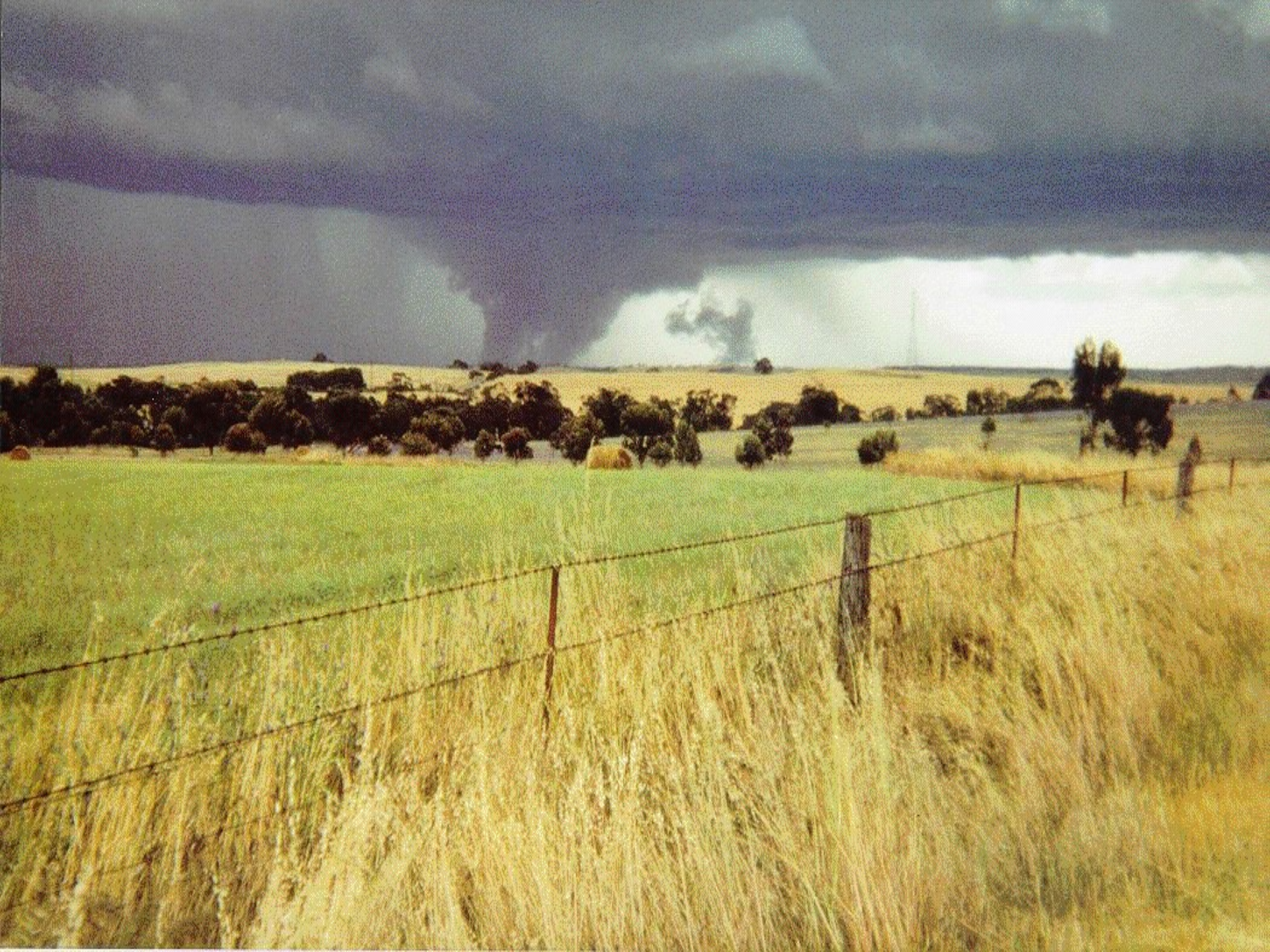
**Category F2:** **Significant tornado (113-157 mph);** considerable damage. roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light-object missiles generated.

**Category F3:** **Severe tornado (158-206 mph);** Severe damage. Roofs and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted; heavy cars lifted off ground and thrown.

**Category F4:** **Devastating tornado (207-260 mph);** Devastating damage. Well-constructed houses leveled; structure with weak foundation blown off some distance; cars thrown and large missiles generated.

**Category F5:** **Incredible tornado (261-318 mph);** Incredible damage. Strong frame houses lifted off foundations and carried







“Rope”, or decaying stage of a mature tornado

